Chapter 1
Innovative Technologies for an Engaging Classroom (iTEC)

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Abstract The iTEC project developed a process that allows schools to rethink how they are currently using ICT, and which provides concrete guidance and tools to help them close what is being called the "mainstreaming gap", where technology is not yet fully harnessed as a systemic part of everyday classroom practice that integrates learning both in and out of school. A key element in the approach is to bring together policy makers, researchers, technology suppliers and teachers to develop future classroom scenarios. These scenarios both engage and challenge schools to rethink their current practice and allow them to develop pedagogically advanced Learning Activities that enable a school to upscale its use of ICT and adapt to changing socio-economic conditions. A "Future Classroom Toolkit" has been produced to support wide-scale adoption of the iTEC approach to help schools to design innovative Learning Activities and carry out classroom pilots. This piloting has been carried out on a scale never before attempted in a pan-European project; over 2500 classrooms piloted Learning Activities based on the iTEC Future Classroom scenarios. It is increasingly clear from work in iTEC that the mainstreaming gap needs bottom-up as well as top-down actions, and particularly requires each school to be able to innovate with ICT and develop a sustainable change management process on its own terms and at its own pace.

Keywords Uptake of ICT • Re-engineering • Innovative technologies • School education • Policy making

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Rationale for Re-engineering the Uptake of ICT in Schools

Reaping the benefits of ICT in education is, however, not an easy endeavour. Research confirms broad benefits; however demonstrators are not scaling up as expected—and cost is only part of the problem. The project was set up with a back drop that too many previous future classroom designs had been technology-driven, based on blue-sky thinking or a "rigorous imagining" approach that had little visible impact on schools and teachers. A number of the scenarios that have been influential at European level in terms of technology-enhanced learning research have even declared the school to be redundant or "over". However, at the time this project was conceived, Ministries of Education were not calling for more blue-sky visions. On the contrary, the view from some ministries was that while radical future classroom scenarios involving emerging technologies may provide useful food for thought, they can also intimidate or even alienate many teachers and could be counterproductive as far as mainstreaming is concerned.

Therefore, the focus of our work was to address the transition from new ideas to a full uptake of developed products, services and processes, based on solid principles.

Among the approaches taken into consideration for addressing this issue were the adoption life cycle for Learning Technologies by CETIS,[1] the design science approach of Hevner and Chatterjee (2010), the design science research methodology for IS research (Peffers et al. 2007), and the benefits realisation management (BRM) approach (Bradley 2010). A simple model is depicted in Fig. 1.1.

iTEC's strategic vision is grounded in the belief that the greatest impact can be achieved by **improving the mainstreaming process of current and emerging technologies into evolving educational contexts**. From this perspective, one of the most substantial contributions the project has made to the educational community is an approach (supported by appropriate tools, techniques and frameworks) that can

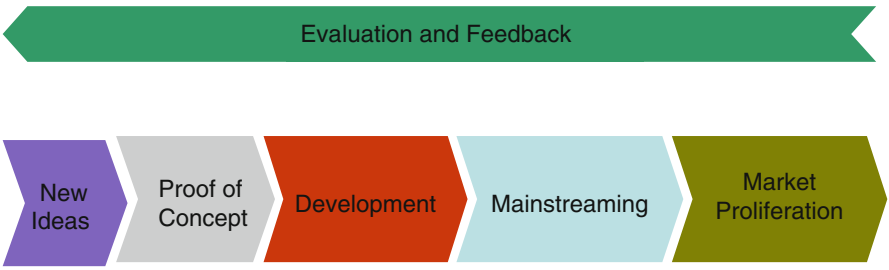

Fig. 1.1 The innovation cycle

[1] http://www.cetis.ac.uk/

stand the test of time and be used for future emerging technologies and that can be used across Europe. There is an old saying: "Give a man a fish and you feed him for a day; teach a man to fish and you feed him for a lifetime". Similarly, iTEC sought to improve, exemplify and support a mainstreaming *approach* rather than to provide a few isolated and unsustainable examples of successful Research and Development showcases of hyped technology, out of date in 5 years.

Education systems adapt slowly for reasons which in some cases are understandable (social cohesion, transmission of enduring values, political pressure) yet technology (and its promise for learning) is evolving at an increasing speed. In such a context, the effectiveness of mainstreaming processes is often the most significant determining factor in changing practice and capitalizing on what ICT can offer. Mainstreaming processes should not only foster the uptake of innovative practices and of technologies but also improve the detection of risks and barriers, in order to avoid mainstreaming efforts that are likely to fail.

Barriers to the mainstreaming of technologies have been studied since the beginning of Technology Enhanced Learning (TEL). For example, the first large scale European project about TEL in schools, e.g., he Web for Schools project of 1996 (see Van Assche 1998), as well as more recent studies (European Commission 2013) reported the limited time of teachers, the lack of good ICT practice in teacher education, the constraints of the curriculum, the lack of teacher confidence (teachers being scared and intimidated by their student's increasing knowledge about Internet and communication devices), lack of pedagogical teacher education; lack of suitable educational software, limited access to ICT; rigid structure of traditional education systems, etc.

Typically, such barriers are part of the debate about innovation versus traditional approaches. A NESTA report on this subject (Luckin et al. 2012, p. 63) confirms many of these barriers but also identifies opportunities and confirms the iTEC findings while concluding:

> *We found proof by putting learning first. We have shown how different technologies can improve learning by augmenting and connecting proven learning activities… there is also a great deal that can be done with existing technology. It is clear that there is no single technology that is 'best' for learning.*

Most significantly, with the increasing confidence of practitioners, the prevailing culture of education practice is changing towards an understanding that innovation and experimentation should be embraced as a solution to challenges in the classroom.

iTEC has been working towards a vision in the future where the pace of change in the classroom has become significantly more aligned with the pace of change and use of technology in society; where technologies supporting creativity, collaboration and communication have become common in the workplace and everyday lives, and the ubiquitous nature of this technology, and the affordances it brings, is mirrored by its use in schools across Europe; where schools are no longer an oasis of "low tech" and traditional didactic interaction.

Supporting the Uptake of ICT in Schools

The uptake of ICT in schools was in iTEC supported by eight strands of activity (Ellis 2014), based on the iTEC evaluation findings, ongoing consultation with partners and the recommendations of the external experts. These strands are (see Fig. 1.2):

1. The Future Classroom Toolkit (the main output)
2. An Initial Teacher Education network and emerging network of Future Classroom Labs
3. The Future Classroom Ambassador scheme
4. Continuing Professional Development (CPD)
5. A family of related projects (see below for examples)
6. Influencing national policy and strategy
7. Exploitation of iTEC technical research and industry collaboration
8. Further engagement with school leaders and teacher communities

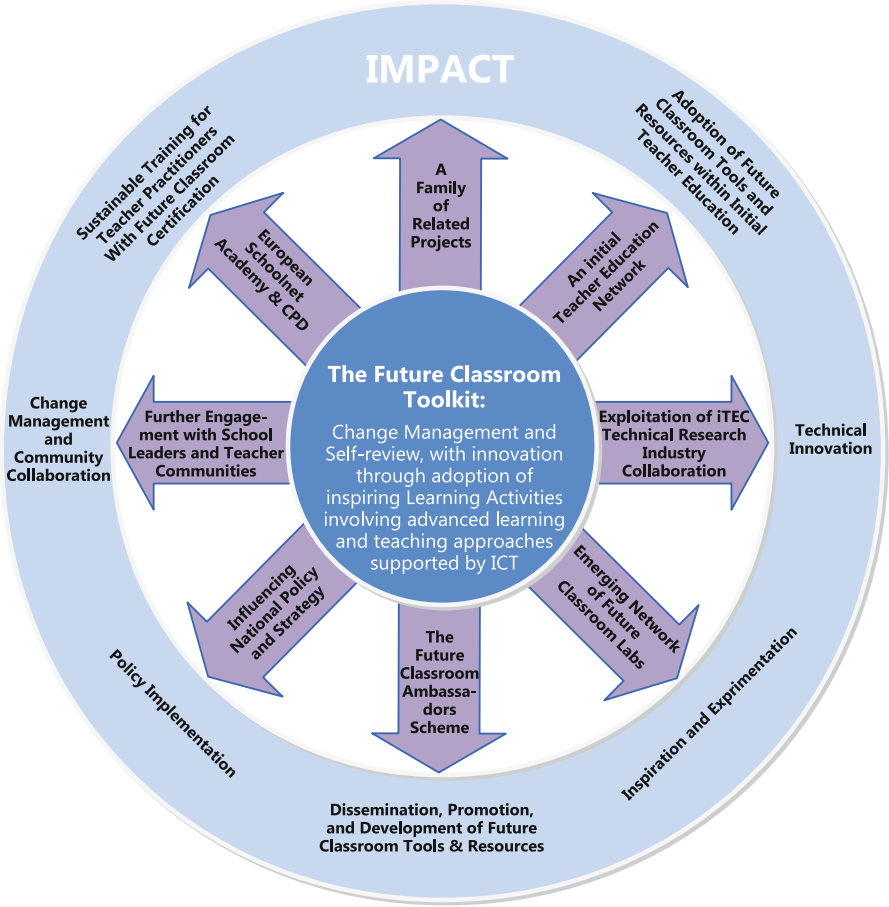

Fig. 1.2 Eight strands of ICT uptake that reinforce each other

The Future Classroom Toolkit

The iTEC project partnership was very successful in developing and adapting the processes for scenario development and learning activity design. The consortium delivered a well thought through set of tools and techniques for achieving this through the Future Classroom Toolkit, including a solid bank of Future Classroom Scenarios and Learning Activities.

This Future Classroom Toolkit provides a "clear narrative" for a "change management" oriented workflow that starts with creating a vision of innovation, captured in scenarios. In iTEC, a **scenario** is defined as a narrative description of teaching and learning that provides a vision for innovation and advanced pedagogical practice, making effective use of ICT. Next, the workflow proceeds through to the practical implementation of Learning Activities and classroom validation. These **Learning Activities** are detailed descriptions of novel (at least in the iTEC context) teaching and learning in classrooms. These detailed descriptions include the resources to be used, the context (e.g., the location), the roles of participants, etc.

This workflow is supported by tools for learning design, maturity modelling, finding resources, etc. In guiding users through the tools and processes, the toolkit itself acts as a method of training and professional development, rather than simply a resource repository. The toolkit takes the following into consideration:

- Target Audience—Initially school leaders and advanced teachers, but also targeting other groups particularly Initial Teacher Education organisations, Continuous Professional development (CPD) providers and ICT suppliers.
- Inclusion of video materials, learner stories and teacher stories (repository of experiences).
- Perspectives of school leaders and learners.

There are different strategies for developing scenarios and Learning Activities. While initially it may be advisable to centrally manage, in a top-down manner, the creation of scenarios and Learning Activities, eventually it should be possible for other stakeholders to replicate the processes in order to create their own resources. The strategy to devolve the design processes across the iTEC partnership was an essential first step in enabling the ongoing development of relevant scenarios and Learning Activities, and ensuring that these outputs meet the local needs of users, e.g., by responding to local trends, opportunities and constraints.

A Teacher Education Network and Emerging Network of Future Classroom Labs

Teacher competencies are at the heart of effective education systems, yet consultation with partners and Initial Teacher Education (ITE) organisations has revealed that teacher education does not adequately cover innovation and change, and technology-supported pedagogical practices.

Workshops with ITE organisations have confirmed that the design of Learning Activities is well suited to preparing trainee teachers for their classroom practice. This has led to the set-up of an ITE network that will work collaboratively to research and summarise current developments and trends in teacher education. The ITE providers within the network will assess the effectiveness of the iTEC/Future Classroom model and its potential for use in other European countries.

The expected outcomes of this network are:

- A Future Classroom Toolkit, tailored for adoption and adaptation by ITE providers.
- A published set of case studies showing how a diversity of ITE providers can adopt the tools and resources within their own training provision.
- A sustainability plan showing how the Future Classroom training programme and resources can be maintained and adopted at scale by ITE organisations.

A second approach to establishing this network is to link interested parties with the development of a network of Future Classroom Labs. The project decided that an important part of the iTEC 'value proposition' would be to provide physical environments in which iTEC Future Classroom Scenarios, Learning Activities and best practices could be showcased and demonstrated to policy makers, industry partners, school leaders and teachers. The Future Classroom Lab[2] (FCL) concept was developed by European Schoolnet in parallel to the iTEC project and is now an independently funded initiative supported by European Schoolnet and 35 industry partners. The FCL consists of a room designed as an interactive classroom, to illustrate how a traditional classroom setting can use technology to enhance interactivity and student participation, plus a large reconfigurable open space equipped with the latest technology. As iTEC results and training courses were heavily promoted via the Future Classroom Lab over the last 18 months of the project, one totally unforeseen consequence of this iTEC activity has been an increasing interest from both Ministries of Education and schools in replicating elements of the Future Classroom Lab at the European Schoolnet[3] in Brussels, in a variety of countries. Teaching rooms inspired by this lab, have now been established in schools in Ancona in Italy, Ghent in Belgium, Setubal in Portugal, Crema in Italy, Zagreb in Croatia, and Tallinn in Estonia, and many others are in the process of implementation. See examples in Figs. 1.3 and 1.4.

[2] Future Classroom Lab, http://flc.eun.org

[3] European Schoolnet is a network of 30 European Ministries of Education. See http://www.eun.org/

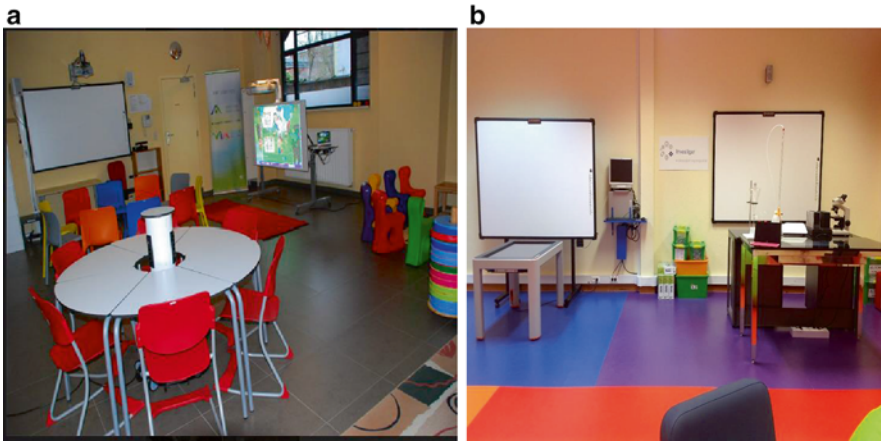

Fig. 1.3 The Future Classroom Labs in Ghent (Belgium) and Setubal (Portugal)

Fig. 1.4 The Future Classroom Labs in Tallinn (Estonia) and Ancona (Italy)

A Future Classroom Ambassadors Scheme

Communicating iTEC to a wider audience has been a challenge, and the "Future Classroom" discussion regularly opens up a debate about innovation verses traditional approaches. However, the iTEC project has presented some clear and well-targeted messages, which have helped engage stakeholders. Perhaps the most important message has been to emphasise that iTEC is about advances and innovation in learning and teaching, not about "pushing" ICT into schools. Whilst evidence shows that teachers largely appreciate the value of technology, they can still be understandably threatened by initiatives which put the technology before the needs of learners, or the reality of the classroom. Another message, that was

reflected back across the consortium during the project, is that radical innovation driven by new technology is not likely to be mainstreamed. Pilots were designed to move teachers sufficiently outside of their comfort zone to ensure sustainable change, and tools such as the Future Classroom Maturity Model were designed to ensure this.

Communicating this set of messages has been through an advocacy approach, rather than a top down approach. National Coordinators, in touch with teacher realities were critical to the early success of the project and, in later cycles, the work to spread iTEC resources and ideas was taken on by the teachers who had participated in pilots. The value of teacher ambassadors either formally appointed, or informally self-appointed in some cases, has been demonstrated.

Continuing Professional Development

Already for decades, teacher professional development initiatives are mostly seen as a key component of using ICT in the classroom, with a variety of online and offline training programmes developed out of the experience. However, once again, the focus on advancing pedagogical practice rather than just technical skills is the subtle but powerful approach. The Future Classroom Lab (FCL) has continued to prove itself as a valuable asset in this, supporting teachers as they carry out pilots in their own schools using the Learning Activities that they have collectively developed in the Lab.

Obviously, CPD requires localization and a way of achieving this is through a train-the-trainers programme. In an initial 2 day course, partners get training on how to develop their own course for local schools based on the use of the Future Classroom Toolkit. This will include access to course materials and resources that can be repurposed and full access to the Future Classroom Toolkit (including future developments). Similarly, this training is offered to industry partners.

Continued and Related Research and Development

An important part of the overall vision for the uptake of ICT in schools has been to ensure that the iTEC's R&D is not a stand-alone activity but is part of a 'family' of related R&D efforts. Examples of such continued and related R&D are:

The CPD*Lab* project[4] which was consciously designed to leverage, consolidate and help sustain the work being carried out in iTEC related to the professional

[4] Continuing Professional Development Lab (CPDLab), http://cpdlab.eun.org

development of teachers. The 5-day Future Classroom Scenarios course developed in CPD*Lab* was first delivered in the FCL in Brussels in summer 2013 to teachers who had received Comenius funding and a second version of this course (*Future Classroom—adapting pedagogical practice*) was offered in spring 2014. Shorter versions of the course have also been run in two-day workshops for eTwinning[5] teachers in the FCL.

The second project, Living Schools Lab[6] (LSL), has explored new models for mainstreaming innovative practice by establishing a network where Advanced Practitioners work with Advanced Schools based around regional clusters. As well as impacting on the extensive professional development programme that has been provided for LSL teachers, iTEC and LSL started to put in place a new mechanism to allow exchanges with head teachers to take place on a regular basis under the FCL umbrella.

The third project, Creative Classrooms Lab[7] (CCL) is carrying out a series of policy experimentations on the use of tablets in schools involving nine Ministries of Education. In the first year of the project, policy makers and teachers in CCL followed the iTEC process to create tablet scenarios (related to collaboration, content creation, flipped classroom, and personalisation) and Learning Activities that were piloted in 45 classrooms in eight countries. As in iTEC, the CCL scenarios are included within a new bank of Future Classroom Scenarios and Learning Activities.[8]

Influencing National Policy and Strategy

For the outcomes of iTEC to feature in any emerging policy or strategy initiative, the timing of policy-making, competing political pressures, and economic considerations all have to be factored in. While in some countries the political context does support a top down intervention, this approach is not viable in every case. There are indeed cases where the political system does not support any intervention e.g., Portugal and the Slovak Republic where there is no specific policy initiative likely to focus on education and ICT, and in Flemish Belgium where it is accepted that the role of government is not to intervene in learning and teaching. Therefore, iTEC sought to achieve impact in a more direct way, through engagement with the different agencies and mechanisms that exist in each country, with the role of putting national policy into practice.

[5] http://www.etwinning.net/

[6] Living Schools Lab (LSL), http://lsl.eun.org

[7] Creative Classrooms Lab (CCL), http://creative.eun.org

[8] http://creative.eun.org/scenarios

Assessment by a Group of Senior Advisors

The iTEC project established a High Level Group (HLG) of senior advisors and policy makers (that included two former ministers of education) which assessed the iTEC outcomes, identifying a number of challenges and enabling factors for the uptake of ICT in schools.

Implementation Challenges

Despite widespread support from participants and stakeholders in iTEC, a key challenge in the exploitation of the results was engaging the attention and support of a wider group of key education influencers and persuading them to mainstream the project's innovative practices. To achieve this, project outputs must continue to be communicated effectively to those key influencers to encourage them and move them to action.

Clear messaging must continue to be developed and communicated, for those specific stakeholders. Messaging should highlight compelling evidence, and address where appropriate, factors that might be used to diminish or undermine progress. HLG members, representing the perspective of senior policy makers provided valuable insight into perceptions of such stakeholders and identified challenges that might present barriers to policy maker engagement.

Different Results in Different Countries

While the project involved practice in over 2500 classrooms, geographic distribution of classrooms was not even across Europe which could suggest that iTEC results are more appropriate to some countries, and less appropriate to others. With 20 pilot countries, it is perhaps not surprising that there are differences in approach that, arguably, should be further explored. Structures and systems, capacity for innovation and change, pre-existing relationships between students and teachers, and attitudes toward professional development all contribute to the differences in results between countries. Timing might also be considered important, with each country at a different stage in the cycle of reform, and travelling in quite different directions. A finding here is that resistance is often *not* caused by scepticism and *can* be mitigated by better contextualising the use of tools and approaches, such as in iTEC, in terms of readiness for classroom innovation.

Suggesting the Results of iTEC Are Influenced by Classroom Self-selection

It could be suggested that projects introducing emerging ICT only work in schools with teachers who are already innovative and enthusiastic. As a result, it could be proposed that scaling may not be possible because the precondition of innovative and enthusiastic teachers may not be in place. However, the first counter argument

should perhaps be developing the conditions in which enthusiastic innovative teachers become the norm rather than the exception. Top down imposition is seldom an answer. Further evidence of the limitations of a top down approach comes from a group of teachers who participated in an Education Fast Forward[9] debate. The teachers reported that authorities were introducing a requirement for them to be collaborative. Their reaction was to withdraw their labour, an unintended outcome from a top down instruction.

However, the experience in iTEC was that self-selection meant that the teachers who did participate were effectively teacher leaders. There is evidence within the project that such teachers actively spread iTEC practices and messages to other teachers, in a way that was most acceptable to them (rather than a top down approach). That bottom up, organic approach, often associated with creation of movements, may ultimately be more powerful. In these circumstances, advanced, innovative and enthusiastic teachers are empowered to take a lead within their profession and to act as ambassadors.

Cost of Scaling Up Teacher Training

The cost of scaling teacher training is dependent on local or national circumstances. The OECD (2014) publication indicates some of the factors that influence participation in professional development activities. It should be noted that it is based on direct feedback from teachers. "TALIS[10] finds that, across participating countries and economies, teachers most often cite conflicts with their work schedule (51 % of teachers) and a lack of incentives (48 %) as barriers to participating in professional development activities".[11] In comparison, evidence from the Survey of Schools : ICT in Education[12] shows that, as regards ICT, there is much self-directed, ad hoc, CPD in teachers' own time: across the EU 74 % of grade 8 students are in schools where this is the case, demonstrating a high level of willingness to learn about ICT. The Survey suggests that this learning is in isolation however: only 28 % of grade 11 general students are in schools where teachers have taken part in online communities of fellow educators. This suggested an untapped opportunity to develop online social CPD offerings. We therefore argue that when teachers are suitably motivated, and training resources are of sufficient quality and availability, teachers can effectively engage in valuable CPD at low cost and at scale online. This evidence has led to further development in online flexible training programmes which many of the iTEC partners have produced as, a direct consequence of iTEC. A prominent example is the European Schoolnet Academy[13] that started to offer free online courses lasting 6–8 weeks for teachers' professional development.

[9] http://www.effdebate.org/

[10] Teaching and Learning International Survey

[11] OECD (2014, p. 13)

[12] European Commission (2013, p. 75)

[13] http://www.europeanschoolnetacademy.eu/

Getting the Message and Language Correct for the Diverse Political Contexts of Europe

A central challenge was that there was no uniform way of promoting iTEC effectively and efficiently that would work across all countries and their contexts, owing to the significant differences in policy, culture, language, perceptions of education and its structures, etc. Strengths and positive outputs of projects such as iTEC play differently within different government philosophies and priorities. As a result, messages should be tailored for each circumstance in order to ensure a good fit with local and national policy. In the case of iTEC, the project has benefited from direct links to policy priorities across many countries, thanks to the involvement of Ministries of Education. Consequently, in some areas iTEC developments have gained near universal acceptance (e.g., influencing initial teacher education); there is unanimous agreement on the need for iTEC to seriously impact on ITE but this remains a challenge. Also here the right message and language must be used as ITE institutions operate quite independently in terms of their curriculum.

Similar consideration needs to be given to language used to promote iTEC's outputs. Terminology such as "21st Century Skills" and "Future Classroom" can invite cynicism and suspicion in some circumstances, but are persuasive in others. For example, "future" may give a sense of unobtainable fantasy to some, while to others it can be entirely appropriate. It is clearly important to understand the particular vocabulary of policy-makers and to avoid those commonly used terms and clichés that can lead to negative reactions.

Investment in Prototypes

While the iTEC process has proven itself, within the context of the project, the resulting toolkit was described by one member of the High Level Group of senior advisors as a "train without a rail network". This description was intended to highlight that the toolkit is a valuable resource, but appropriate infrastructure needs to be in place for it to show its true value. Funding tends to be drawn towards small-scale research projects, or infrastructure initiatives that rapidly provide more visibly concrete outputs, rather than long term initiatives that can impact working practices more subtly and more fundamentally.

Linked to this, is evidence of impact on learner achievement. This was outside the iTEC project's scope, but may present an additional challenge for acceptance and adoption of iTEC outcomes, particularly if further investment is required. While the evaluation results give very good evidence of the benefits in terms of motivation and engagement by learners together with improvements in twenty-first century skills, many policy makers are fundamentally concerned with evidence of learners achieving improved results in exams.

Strengths Supporting Implementation

The High Level Group of senior advisors identified strengths of iTEC, which are seen as offering the most compelling arguments to attract support and investment from policy makers and to enable wider impact of iTEC's outputs. The identified strengths were important for iTEC, but are in general worthwhile for any Technology Enhanced Learning project.

Engagement of Teachers at Low Cost

It can be universally appreciated, that any action that can positively motivate and inspire teachers is worthy of consideration. If such motivation is clearly cost effective then adoption is even more compelling. This is perhaps the key component of iTEC's work. There is good evidence to show that teachers were engaged, enthusiastic and motivated by iTEC, even though teachers were not paid to participate and effectively encountered additional burdens and challenges. The enthusiasm to participate was reinforced by involvement of several additional countries and regions in iTEC. These countries played active roles in the project without receiving any funding for doing so. The countries included Spain, Finland and the Czech Republic.

Innovation in Practice Involving a Large Number of Teachers

With over 2500 classrooms participating in the project, iTEC stands out for its size. It should also be emphasised that this project is not based on theory and research alone, but has demonstrated the possibility to bring change in practice at scale. Large-scale validation projects involving (the practice of) thousands of teachers, such as iTEC, help raise a project's profile and validity.

Promoting Teacher Community Collaboration

iTEC, through both its technical and pedagogical activities, has exploited the trend of social networking to encourage teaching professionals to use such tools and share resources, ideas and practices at low cost and high scale. iTEC has shown that when teachers work in collaboration, and collaborate together in communities, many benefits can result. Collaboration and community-based action have the potential to reduce costs of administration and to encourage development and change, appropriate to local groups, individuals and organizations. Technology is often seen as being at the core of this change.

Focus on Learning and Teaching, Cross-Curriculum and Cross Age Group

The principles and practices established as a part of iTEC can be applied in any subject area or age group. Policy makers can therefore engage these principles and practices for a wide range of policy initiatives, and thereby be helped in policy formulation and implementation. In addition, it should be noted that iTEC's processes are not driven by technology, but instead by pedagogy. It is widely suggested that, too often, projects and initiatives focus on a technology as the main driving force, while fundamental learning aims are forgotten and pedagogy underserved. Evidence from teachers in iTEC highlights changing and positive relationships developed within classrooms, and a positive impact on learning. Teachers' digital competencies and pedagogy were enhanced, and teachers became more enthusiastic about their pedagogical practices.

Conclusions

Based on extensive testing within the iTEC project, the Future Classroom Toolkit proved to have great potential in achieving wide scale innovation. The toolkit was made available in seven languages (English, French, Portuguese, German, Norwegian, Italian and Spanish) under an open licence allowing use and adaptation, including commercial use.

The scenario development process, elaborated in iTEC, provides a professional approach to developing, documenting and disseminating innovative practices. The process supports an approach to rethinking pedagogy with technology that is not technology-led but pedagogically-led.

It also encourages teachers to consider themselves **learning designers**, to vary the range of activities and to focus on what students (not the teacher) are doing. It brings a wider range of stakeholders together, enables a focus on local priorities and provides a standardised approach. The outcomes of the scenarios, the Learning Stories and Learning Activities, are perceived to offer a structured approach for introducing new technologies into classroom practices. These resources are seen by many to be innovative for teachers and important enablers of change because they provide concrete and well-structured examples, emphasise innovation and offer flexibility whilst being easy to use.

Experience shows that the iTEC process will not be "transferred" and adopted by the majority of schools simply as a result of exhortation or advocacy or showcasing these large-scale pilots at national level. For example, the European Commission[14] states that: "Campaigns aimed at school heads and teachers to convince them of the relevance and positive impact of ICT use are no longer of value". Centrally driven

[14] European Commission (2013, p. 121)

dissemination campaigns may also struggle to be effective unless practitioners, and those involved in teacher professional development and initial teacher education organisations are provided with new tools for rethinking teaching and learning and which support change management. It is increasingly clear from work in iTEC that the mainstreaming gap concerning ICT use in schools needs bottom-up as well as top-down actions, and particularly requires each school to be able to innovate with ICT and develop a sustainable change management process on its own terms and at its own pace.

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